

*one-third the capacity of the digital television signal. Thus, if a television broadcaster were to split its capacity—half to television and half to mobile applications—it would be able to provide a 10 megabit per second television stream and a 3 megabit per second mobile service. Such a capacity division would still permit the broadcaster to transmit a video signal for providing local video service and qualifying for cable/satellite must-carry.*

Such a capacity split would give a single broadcaster about three-fourths the capacity (measured in bits per second) of XM or Sirius. However, because of the high powers and lower frequencies used for television broadcasting, the broadcaster's signal would provide far better service indoors and would have fewer coverage holes outdoors than the XM/Sirius signals.

A broadcaster might choose an alternative capacity split—say 6 megabits per second for television and 4 megabits per second for a mobile service—and thereby match the capacity of XM or Sirius.

Broadcasters are unlikely to offer a simple audio service. Instead, they can be expected to offer a service that is a mix of audio, video, and data services—a mix that many consumers may find more attractive than an audio-only service.

## ***Broadband Terrestrial Service Providers***

### **MediaFLO**

QUALCOMM, a communications technology firm that also offers some wireless services, has nationwide licenses to operate on the 6-megahertz-wide D channel in the lower 700 megahertz allocation (the old channel 55 at 716–722 megahertz).<sup>10</sup>

QUALCOMM has chosen to use a technology of its own design, known as MediaFLO, to provide service in this band. QUALCOMM began service in 2006 and has been working hard to expand coverage since then; QUALCOMM will have access to the band at all geographic locations by February 17, 2009—the date for the completion of the

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<sup>10</sup> The D channel corresponds to television channel 55. After the digital transition, broadcast operations in this band will cease, and QUALCOMM will be able to use it nationwide without any concern for protecting the reception of television signals on channel 55.

conversion to digital television broadcasting.<sup>11</sup> QUALCOMM operates as a wholesaler to service providers. *MediaFLO is already providing services in 36 metropolitan markets across 22 states through Verizon Wireless's V Cast Mobile TV service and continues to expand to other markets nationwide.*<sup>12</sup> AT&T Wireless also plans to launch a mobile TV service through MediaFLO later this year.<sup>13</sup>

MediaFLO is designed to serve receivers moving at speeds up to about 100 miles per hour. The data rate achieved by MediaFLO can be varied by the operator—who can trade off coverage (range) against bit rate. The bit rate of MediaFLO operating in a 6-megahertz channel can be as high as 11.2 megabits per second; however, 4 to 6 megabits per second probably better describes the capacity of a typical MediaFLO configuration. QUALCOMM claims that MediaFLO can transmit about 20 video channels together with 10 audio channels, each video channel requiring a nominal 0.3 megabits per second.<sup>14</sup> The specific capacity depends on the programming mix (sports require more capacity than do animated cartoons) and how coverage has been engineered in a specific region.

If QUALCOMM were to devote about half of the MediaFLO capacity to audio services and if the average audio service required 20 to 30 kilobits per second to carry the service, then QUALCOMM would be able to deliver 100 audio channels while still providing 10 video channels. The best mix of video and audio is unclear; the top 20 XM channels account for half of XM's total listening audience.<sup>15</sup> QUALCOMM may not need 200 channels in order to provide an option that attracts many customers.

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<sup>11</sup> QUALCOMM can operate in some locations without concern for interference to television reception. In many areas where such interference is a concern, QUALCOMM has negotiated agreements with broadcasters that permit MediaFLO to operate. These agreements are reviewed by the FCC and do not go into effect if the FCC finds that the terms of the agreement will permit unacceptable harm to television reception.

<sup>12</sup> <http://getitnow.vzwshop.com/index.aspx?id=mobileTV>;  
<http://news.vzw.com/news/2007/07/pr2007-07-16.html>.

<sup>13</sup> "AT&T Selects Qualcomm's MediaFLO USA for Mobile Entertainment Services," *at* [http://www.qualcomm.com/press/releases/2007/070212\\_att\\_selects\\_s\\_print.html](http://www.qualcomm.com/press/releases/2007/070212_att_selects_s_print.html).

<sup>14</sup> *MediaFLO: FLO™ Technology Overview*, at 20 Table 5 (2007) (noting ability to support 20 video channels); Press Release, "QUALCOMM and Samsung Electronics Conduct First Public Demonstration of FLO™ Technology on a UMTS Handset," Apr. 4, 2006, *at* <http://www.mediafloodusa.com/content/newsroom/article9.shtml>.

<sup>15</sup> The top 20 XM channels accounted for 49.2% AQH share in the Spring quarter 2007 OTX Audience Measurement Survey.

Although QUALCOMM's MediaFLO system is limited to terrestrial transmitters, it is important to note that MediaFLO operates with a center frequency of 719 megahertz, compared with SDARS, which operates at a center frequency of 2332.5 megahertz—a ratio of more than 3:1 in frequency. QUALCOMM's licenses permit 50 kilowatt power output, significantly higher than the power permitted XM and Sirius for their terrestrial repeaters. MediaFLO's technical advantages of lower frequency and higher power allow MediaFLO to obtain terrestrial coverage better than that provided by the terrestrial component of XM/Sirius for substantially less investment.<sup>16</sup> In addition, those lower MediaFLO frequencies penetrate buildings more readily than do the frequencies used by XM/Sirius. Thus, QUALCOMM can build a MediaFLO system providing excellent coverage in urban areas and good coverage inside many buildings for substantially less investment than can XM/Sirius. The XM/Sirius satellites have a much broader geographic footprint than QUALCOMM has, but the lower frequencies used by MediaFLO permit QUALCOMM to provide more reliable service in the locations where most people live and work.

Of course, at present it seems unlikely that QUALCOMM, or its resale customers, will devote all, or even half, of its capacity to audio services. Rather, QUALCOMM can be expected to offer a menu of audio, video, and data services. But, if there is great demand for multi-channel audio services, QUALCOMM can easily shift its capacity into audio services. It may also be the case that a service that provides a mix of video, audio, and other services will be more attractive to consumers than an audio-only service.<sup>17</sup>

To sum up, MediaFLO operates today in 36 markets across the country and has distribution agreements with the top two wireless carriers (representing over 120 million

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<sup>16</sup> It is generally accepted that lower frequencies provide better coverage and that the number of transmitter sites required to provide equivalent coverage for a one-way service is roughly proportional to the ratio of the higher and lower frequencies—that is, a system operating at 2100 megahertz will require about three times as many transmitter sites as one operating at 700 megahertz. This rule is correct in many circumstances although it is not always correct, and it certainly is not an expression of a universal physical law. However, it is an appropriate model in this case.

<sup>17</sup> Consumer demand for more than just audio service may lie behind Sirius's new offering of "Backseat TV." See <http://www.sirius.com/servlet/ContentServer?pagename=Sirius/Page&c=FlexContent&cid=117492895533> 9.

subscribers); its network provides a terrestrial transmission capacity that—measured in bits per second—is roughly equal to that of XM/Sirius combined. The MediaFLO technology permits this capacity to be used for video, audio, and data services.

### **Hiwire (Aloha Partners)**

Hiwire, an operating entity owned by an investment group named Aloha Partners, holds licenses for a significant portion of the C Block in the lower 700 megahertz band (710–716 megahertz paired with 740–746 megahertz—old television channels 54 and 59) that was auctioned by the FCC in 2002. Aloha describes itself saying, “Aloha currently owns 12 MHz of spectrum covering 60% of the United States—including all of the top 10 markets and over 85% of the population in the top 50 markets.”<sup>18</sup>

Hiwire’s spectrum is similar to that of QUALCOMM; an important difference is that Hiwire has access to 12 megahertz—twice QUALCOMM’s 6 megahertz. Hiwire’s system will have the same physical advantages—better coverage at lower cost and better building penetration—over the SDARS terrestrial component as does QUALCOMM’s system.

Hiwire has announced plans to deploy a multi-media broadcasting service using the DVB-H standard in its spectrum.<sup>19</sup> The technical capabilities of Hiwire’s service will be similar to those of QUALCOMM—except for Hiwire’s two-to-one bandwidth advantage over MediaFLO.

### **Crown Castle/Modeo**

Crown Castle, a firm that owns many towers and antenna sites across the nation and is in the business of renting tower space to wireless service providers, purchased a nationwide license to the band 1670–1675 megahertz. Thus, Crown Castle has a spectrum situation quite similar to that of QUALCOMM on the lower 700 megahertz D Block as described above. There are two major differences. First, the Crown Castle license has a center frequency of 1672.5 megahertz—more than twice as high as that of QUALCOMM.

<sup>18</sup> [http://www.alohapartners.net/ap\\_overview.htm](http://www.alohapartners.net/ap_overview.htm).

<sup>19</sup> Olga Kharif, *Hiwire's High-Wire Act*, BUSINESS WEEK, Aug. 30, 2006, available at [http://www.businessweek.com/technology/content/aug2006/tc20060829\\_420214.htm?chan=top+news\\_top+news+index\\_technology](http://www.businessweek.com/technology/content/aug2006/tc20060829_420214.htm?chan=top+news_top+news+index_technology).

Consequently, Crown Castle will require more transmitting sites than QUALCOMM to get equivalent coverage.<sup>20</sup> Recall, however, that Crown Castle's primary business is antenna sites—so this requirement will be less of a burden on Crown Castle than it would be on other firms. Second, Crown Castle's license is for 5 megahertz—only about 85% of the bandwidth of available to QUALCOMM.

Crown Castle successfully petitioned the FCC for a waiver to allow them to use higher transmit power, thus permitting Crown Castle either to significantly improve their coverage or to lower their build out cost (or to enjoy some mix of better coverage and lower costs). The FCC characterized this waiver as permitting Crown Castle “to provide a one-way (base-to-mobile) nationwide service . . . to wireless handsets with at least 10 video channels and 24 audio channels.”<sup>21</sup> As the FCC explained, “the increased power limits should result in a reduction in the number of base stations required to serve a market, potentially resulting in more rapid deployment of service to the American public. The use of higher power limits should also enable Crown Castle to improve service quality to the public by reducing dead-spots and by increasing in-building coverage.”<sup>22</sup> Crown Castle launched a commercial test of this service in New York in December 2006.<sup>23</sup>

Crown Castle has announced that it will provide its service, which it calls Modeo, using the DVB-H standard. DVB-H is a modified version of the European digital television standard (DVB). It is modified for use with handheld, battery-powered receiving devices, hence the acronym DVB-H. A DVB-H signal carries a stream of packet data. That stream can be used to provide video, audio, or data services. Consequently, Crown Castle's options are similar to those that QUALCOMM has with its 700 megahertz license. Should the market demand be there, Crown Castle has the option of providing a large number of audio channels.

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<sup>20</sup> Notice that the Crown Castle frequency is lower than the SDARS frequency so Crown Castle will have an advantage over XM/Sirius with respect to the number of terrestrial antenna sites.

<sup>21</sup> *OP LLC (Crown Castle International Corp.), Licensee of WPYQ831, Petition for Waiver of Section 27.50(f)(1) of the Commission's Rules*, Memorandum Opinion and Order, File No. 0002271317, at ¶ 4 (rel. Feb. 26, 2007).

<sup>22</sup> *Id.* ¶ 14.

<sup>23</sup> Press Release, *Modeo Launches Live Mobile TV Beta Service in Nation's Largest Metro Area*, Jan. 8, 2007, at [http://www.modeo.com/press\\_07.asp](http://www.modeo.com/press_07.asp) (last visited June 28, 2007).

## **Broadband Radio Service and the Educational Broadband Service**

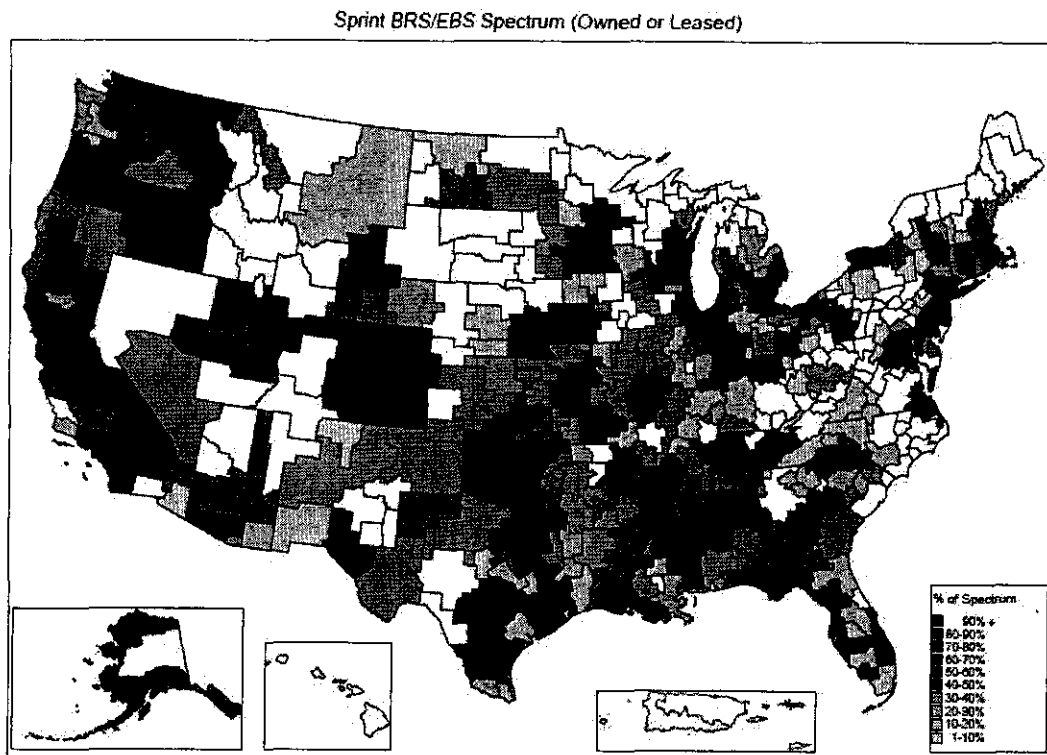
Broadband Radio Service (BRS) and the Educational Broadband Service (EBS) are in the 195 megahertz of spectrum running from 2495–2690 megahertz.<sup>24</sup> This spectrum band has properties similar to those of the bands used by XM and Sirius; the mid-band frequency is about 10% higher than that of the SDARS band. The big disparity is the bandwidth available. XM and Sirius together use about 9 megahertz of spectrum in the terrestrial component of their system—less than 5% of the BRS/EBS band. Devoting even a small portion of the BRS/EBS band to a broadcast audio service would result in a system with more capacity than XM and Sirius combined.

Originally, the BRS/EBS band was used for distributing educational television signals to schools and for wireless cable television service. Currently, a few firms, such as Sprint and Clearwire, are planning to use this band for wireless Internet access. These firms, Sprint in particular, have gained the rights to use large parts of this band over much of the nation. Figure 1, based on materials supplied by Sprint in the Sprint/Nextel merger proceeding, shows the extent of Sprint's coverage in this band.<sup>25</sup>

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<sup>24</sup> These services were formerly known as the multichannel, multipoint distribution service (MMDS) and the instructional television fixed service (ITFS).

<sup>25</sup> Applications of Nextel Communications, Inc., Transferor, and Sprint Corporation, Transferee, for Consent to the Transfer of Control of Entities Holding Commission Licenses and Authorizations Pursuant to Sections 214 and 310(d) of the Communications Act, WT Docket No. 05-63, at Attachment 1 to Attachment E (available at: <https://wireless2.fcc.gov/UlsEntry/attachments/attachmentView.jsp?applType=search&attachmentKey=17993626&affn=0179936268364392058496989>).



**Figure 1. Sprint BRS/EBS Spectrum Coverage**

Sprint and Clearwire announced on July 19, 2007, that they would collaborate on product development, market products under the same brand, and permit users to roam from one network onto the other.<sup>26</sup> Thus, from a consumer point of view, the Sprint and Clearwire BRS/EBS spectrum supports a single service.

The current preferred application for this band, Internet access, permits users to enjoy streaming audio—that is, Sprint and Clearwire’s services provide their users with access to the vast range of Internet audio services—effectively offering an alternative audio service option.

<sup>26</sup> “Clearwire and Sprint Reach Roaming Accord, Amol Sharma,” *Wall Street Journal Online*, July 19, 2007.

A firm operating in this band could easily supplement traditional Internet access with a *broadcast audio service similar to that of XM/Sirius*. If a firm were also supplying broadband access services, it could supplement its broadcast offerings with various on-request programs. And, of course, such a service provider could also download content to handsets during off-peak times for later playback.

To sum up, this spectrum band is technically suited for providing a multi-channel audio service with characteristics similar to those of the terrestrial component of the XM/Sirius systems. This band is substantially larger than the SDARS band.

### ***Commercial Mobile Radio Service Providers***


Wireless carriers already offer both streaming and on-demand download music services. For example, Verizon offers V Cast, a music download service.<sup>27</sup> AT&T sells the iPhone, which can download music from iTunes or other Internet music sites.

MobiTV is a firm that specializes in developing media applications for mobile phones and similar devices. One service MobiTV offers is *mobiradio*—a service that provides streaming audio programming to wireless subscribers. *mobiradio* delivers more than 50 channels of programming. Figure 2 is a copy of a page on the MobiTV website describing this service. Both AT&T and Alltel offer *mobiradio* to their subscribers. Alltel calls its offering *Axxess Radio*; AT&T calls it offering *MobiRadio*.<sup>28</sup> AT&T offers other program services, including TV channels, a personalized weather service, and myspace mobile.

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<sup>27</sup> See [http://getitnow.vzwshop.com/index.aspx?id=music\\_vcast](http://getitnow.vzwshop.com/index.aspx?id=music_vcast).




<sup>28</sup> Alltel describes its service at [http://alltel.com/axcess/tv\\_radio.html?id=0](http://alltel.com/axcess/tv_radio.html?id=0); AT&T describes its version at <http://mediamall.wireless.att.com/sf/storefront/endUserHTMLHome.jsp?dc=CF45301> (click the *mobiradio* icon at the bottom of the page).



Listen to over 50 channels of digital radio on your mobile phone!

Get unlimited access to commercial-free digital music. The latest Hip Hop, R&B, Rock, Jazz, Country, and more.


Catch up on news, sports, and weather by tuning into MobiRadio's latest talk radio additions including NPR, FOX News, ESPN Radio, The Weather Channel, and more!

Now you can take radio with you wherever you go!

Click here to see the full channel line-up!

Get MobiRadio on these AT&T/Cingular phones:



Samsung D407

Find your Phone

- >> AT&T/Cingular SYNC™ from Samsung (A707)
- >> LG CU320
- >> LG CU400
- >> LG CU500
- >> Motorola KPR K1
- >> Motorola L2
- >> Motorola L6
- >> Motorola RAZR
- >> Motorola RAZR V3i
- >> Motorola RAZR V3r
- >> Motorola RAZR V3xx
- >> Motorola SLVP L7
- >> Motorola v190
- >> Motorola v220
- >> Nokia 662
- >> Nokia 6126
- >> Nokia 6620
- >> Nokia 6682
- >> Nokia N75
- >> Samsung A717
- >> Samsung A727
- >> Samsung D347
- >> Samsung D407
- >> Samsung D807
- >> Samsung X507
- >> Samsung ZX10
- >> Samsung ZX20

Start listening to Radio on your phone

1. Go to AT&T/Cingular Mall
2. Select Shop Applications
3. Select Entertainment
4. Choose MobiRadio
5. Follow the onscreen prompt to get MobiRadio

Enjoy Radio On the Go!




Figure 2. Description of the mobiradio Service<sup>29</sup>

Figure 3 shows the channels available on mobiradio as delivered by AT&T. Notice that mobiradio distributes several well-known radio services, including NPR, Fox News, Disney, and the Weather Channel.

<sup>29</sup>

Source: <http://www.mobitv.com/radio/radio.php>.

**AT&T/Cingular MobiRadio Channel Line-up**

**Pop** - Click here for channels  
Hit List Get the best of today's pop, rock, and hip-hop on the planet, straight off the charts! Party Favorites Party with a mix of past-time hits from the '60s to the present.  
90s Jam In the hottest pop, rock, and urban hits of the decade.  
70s Turn in for totally over-the-top pop, rock, and urban songs of the '70s!  
70s Get groovy with the best of pop, rock, and soul hits from one of music's most diverse decades.  
Soft Rock Rel back and enjoy a blend of popular hits and love songs from the '60s to the present.  
Wild Gold (Click Listen to the soundtrack of Rock n' Roll's most prolific era.

**Urban** - Click here for channels  
R&B Hits Hear the very best R&B hits of the '60s, '70s, and now.  
R&B and Hip-hop Get the latest R&B and hip-hop, exclusive content, rare imports, and the Music Channel Montage.  
Classic R&B Get down with Classic R&B, funk, soul, and Motown from the late '60s, '70s, and early '80s.  
Smooth R&B Kick back and unwind with smooth R&B, and sultry slow jams.  
Rap Hear the unrelenting voice of a generation represented by the entire hip-hop nation!

**Rock** - Click here for channels  
Rock out rock several straight up with us 60s.  
Arena Rock Get back to the hard rock, soul, and much more, and Rock your life.  
Classic Rock Catch the hits and album tracks from the pioneers who defined the foundation of today's rock.  
Retro Active Pop your way through the synthesized sounds of post-rock and new wave.  
Metal Prepare yourself for an unrelenting aural assault like no other.  
Adult Alternative Enjoy an eclectic blend of the most highly inspiring songwriters of their generation.  
Alternative Hear the brand-new hits, from artists that continue to redefine the modern rock sound.

**Country** - Click here for channels  
Today's Country Embrace the moment with the biggest hits, this generation's brightest country music stars.  
Classic Country Enjoy the best of country music from the '60s, '70s, and '80s.  
Bluegrass Get that high-innovators.

**Country**  
Today's Country Embrace country music stars.  
Classic Country Enjoy the Legends of Country.  
Bluegrass Get that high-innovators.

**Jazz** - Click here for channels  
Smooth Jazz Experience an eclectic blend of smooth and polished grooves.  
Jazz Groove Get the truth and essence of jazz with beats from throughout jazz music's rich history.  
Blues Get everything blues - from Chicago to the Mississippi Delta!

**Variety** - Click here for channels  
Silverwave Bands of Old School Rap, Classic Disco, and '80s music!  
Big Band & Swing Listen to the swinging sounds from the big band era to today.  
Reggae Groove to reggae, ska, dancehall, soca, and Caribbean rhythms.

**Dance** - Click here for channels  
Dance Catch a non-stop party featuring the biggest club hits and the hottest international DJ mixes.  
Electronic Experience international DJs and exclusive mixes.

**Instrumental** - Click here for channels  
Easy Listening Wrap yourself around the warm feelings of remembrance with string orchestras and great instrumentals.  
Soundscapes Fuel the soul with new age, atmosphere, & world-positive music.

**Classical** - Click here for channels  
Classical Masterpieces Enjoy Classical masterpieces from the world's best musicians.  
Opera Experience the beauty, comedy, and romance of classic operas.  
Light Classical Hear solo instrumentalists, chamber, & orchestral favorites.

**Vocal & Theatrical** - Click here for channels  
Show Tunes Get a front row seat for the best of Broadway and musical theater.  
Singers Standards Rediscover timeless classics from the Great American Songbook.

**News & Talk** - Click here for channels  
MPA An internationally acclaimed producer and distributor of noncommercial news, talk, and entertainment programming.  
FOX News Provides radio stations with hourly newscasts at both top and bottom of the hour, as well as breaking news coverage, anchored by trusted FOX News Channel correspondents 24 hours a day, 7 days a week.  
FOX News Talk Hear, analyze and the pulse of the nation from Bill O'Reilly, John Gibson, Alan Colmes and more. News Talk like only Fox can give you.

**Weather** - Click here for channels  
The Weather Channel Radio At the beach, listening to your favorite tunes, it's nice to know that the sunny day won't be spoiled by that dark cloud looming on the horizon. Tune into one of our five channels for specific weather information, local forecasts or to check on the chance of a rainy commute. Available channels are: National Outlook and Stormwatch, Northeast, Northwest, Southeast, and Southwest.

**Kids** - Click here for channels  
Radio Disney is a 24/7 radio network devoted to kids, tweens and families. The network's current playlist, driven by listener requests, includes Miley Cyrus as Hannah Montana, Jonas Brothers, Corbin Bleu and Kate Voegele.

Figure 3. Description of mobiradio Channels<sup>30</sup>

The major wireless carriers have networks that cover essentially all households and the more frequently driven roads. That is, they have wireless coverage where most people are most of the time.

A wireless telephone service provider's system can be part of a larger system for providing audio services. The iPhone illustrates this—the iPhone can play songs downloaded over the Internet to a computer and then transferred to the iPhone.

In addition to the program services that they provide as part of their service, wireless service providers offer another route to audio services—using web browsers over their 3G data services. A computer user with a 3G PC card modem can connect to music sources such as Real Networks, broadcast stations, or even the web services of XM and Sirius and play streaming music from those sources.<sup>31</sup> The *Wall Street Journal* carried a long story on July 18 describing a service called MyWaves, which provides a large library of video channels for delivery to wireless handsets at no charge.<sup>32</sup> MyWaves channels include commercial content, such as CNN's "Daily Podcast" or "NBC Nightly News," and amateur content such as a video of a dog eating peanut butter.<sup>33</sup>

In summary, wireless telephone service providers have extensive geographic coverage with their wireless signals, substantial spectrum resources, a vendor-customer relationship with 240 million Americans, and customers who carry a battery-powered handset to receive service.

## **Satellite Services**

### **Fixed Satellite Service**

The fixed satellite service (FSS) has long been used to distribute video and audio programming and to provide corporate data networks using V-SAT technology.

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<sup>31</sup> I have used my portable computer and a Verizon Wireless EV/DO PC-card modem to listen to streaming audio from Real Networks, WETA-FM, and XM. Verizon Wireless's acceptable use policy prohibits "excessive consumption of network resources." Constant use of streaming audio may be included in this prohibition.

<sup>32</sup> "Calling All Videos," Jessica E. Vascellaro, *Wall Street Journal*, July 18, 2007, p. D1.

<sup>33</sup> See <http://www.mywaves.com/channels/>.

Historically, FSS receivers have used antennas that are large compared with a handset or portable computer.

However, one firm, Slacker Inc., has announced a plan to use fixed satellites to provide audio services to automobiles.<sup>34</sup> Slacker, a startup company, provides an Internet music service that customizes channels to listeners' preferences. Slacker has announced that it will begin selling a portable handset—the Slacker Personal Radio Player—that can connect via WiFi or USB cable and that can store several hours of programming. Slacker Inc. also announced that Slacker Satellite Car Kits will be available for purchase in 2007. Press accounts indicate that the satellites used in the Slacker service will be Ku-band FSS satellites.<sup>35</sup> In April, Slacker Inc. announced that Lon Levin, a long-time satellite industry executive, had joined Slacker.

Slacker Inc.'s ability to use FSS satellites for a mobile service arises from two principal roots. First, of course, is the continuing revolution in electronics that makes it possible to build systems of enormous complexity at reasonable cost. Second, the FCC has regulated satellite services with a light hand; it has allowed satellite operators great latitude in the technology and applications that they deliver, including mobile services, provided that they properly control interference to other systems.<sup>36</sup>

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<sup>34</sup> See [http://www.slacker.com/company/press/pr\\_03152007.html](http://www.slacker.com/company/press/pr_03152007.html).

<sup>35</sup> [http://blog.wired.com/music/2007/03/slacker\\_steals\\_.html#more](http://blog.wired.com/music/2007/03/slacker_steals_.html#more).

<sup>36</sup> See *Amendment of Parts 2 and 25 of the Commission's Rules to Allocate Spectrum and Adopt Service Rules and Procedures to Govern the use of Vehicle-Mounted Earth Stations in Certain Frequency Bands Allocated to the Fixed-Satellite Service*, Notice of Proposed Rulemaking, IB Docket No. 07-101, at ¶ 1 (rel. May 9, 2007); *Service Rules and Procedures to Govern the Use of Aeronautical Mobile Satellite Service Earth Stations in Frequency Bands Allocated to the Fixed Satellite Service*, Notice of Proposed Rulemaking, 20 FCC Rcd 2906 (2005); *Procedures to Govern the Use of Satellite Earth Stations on Board Vessels in the 5925-6425 MHz/3700-4200 MHz Bands and 14.0-14.5 GHz/11.7-12.2 GHz Bands*, Report and Order, 29 FCC Rcd 674 (2005); *2000 Biennial Regulatory Review—Streamlining and Other Revisions of Part 25 of the Commission's Rules Governing the Licensing of, and Spectrum Usage by, Satellite Network Earth Stations and Space Stations*, Sixth Report and Order and Third Further Notice of Proposed Rulemaking, 20 FCC Rcd 5593 (2005).

## Mobile Satellite Service

The mobile satellite service (MSS) is about to see a remarkable change.<sup>37</sup> Three firms, MSV, Terrestar, and ICO are close to launching hybrid MSS satellite systems that will combine satellite access for universal coverage with terrestrial access links for high capacity in more dense areas. MSV, a licensee in the L-Band, is scheduled to put two high-power Boeing satellites in orbit to support its hybrid service.<sup>38</sup> Terrestar has contracted with Loral for two satellites. ICO is scheduled to launch later this year, and Terrestar is scheduled to launch next year.<sup>39</sup> ICO and Terrestar (both S-Band licensees) each has access to 20 megahertz of spectrum—10 megahertz for downlink operations and 10 megahertz for uplink operations. That spectrum is at 2 gigahertz and has properties similar to those of the spectrum used by XM and Sirius. MSV has about 28 megahertz of spectrum at lower frequencies (about 1600 megahertz).

MSS systems can be used to provide audio entertainment service—or, to be more general—can provide subscription multimedia services. The frequency bands allocated to MSS in the United States are well suited for audio entertainment services. ICO recently reiterated its plan to offer a multi-media subscription service via its licensed 2 gigahertz satellite system.<sup>40</sup> An existing MSS operator has observed that it is possible to use  $2 \times 20$  megahertz of 2 gigahertz spectrum to provide mobile entertainment services akin to satellite radio. For example, one provider has explained that 2 gigahertz of spectrum can be used for services such as “multimedia streaming audio and video delivered directly to small terminals that offer value-added interactivity, store-and-reply

<sup>37</sup> MSS is defined as follows: “Mobile-Satellite Service. A radio communication service: (1) Between mobile earth stations and one or more space stations, or between space stations used by this service; or (2) Between mobile earth stations by means of one or more space stations.” 47 C.F.R. § 2.1(c) (2006).

<sup>38</sup> Press Release, *MSV, ILS Contract to Launch Next-Generation Satellite*, May 15, 2007, at <http://www.msvlp.com/media/press-releases-view.cfm?id=126&yr=2007> (last visited June 28, 2007). The L-Band has the technical capability to support satellite radio, and other countries have allocated the 1452-1492 MHz band (L-band) for SDARS. *Establishment of Rules and Policies for the Digital Audio Radio Satellite Service in the 2310-2360 MHz Frequency Band*, Report and Order, Memorandum Opinion and Order and Further Notice of Proposed Rulemaking, 12 FCC Rcd 5754 ¶ 79 (1997).

<sup>39</sup> News Release, *TerreStar Files FCC Application to Modify its Satellite Launch Milestone*, June 8, 2007, at <http://www.terrestar.com/news/press.html> (last visited June 28, 2007); see also *TMI Communications and Company, Limited Partnership, and TerreStar Networks, Inc. Request to Assign Spectrum LOI Authorization*, Memorandum Opinion and Order, 19 FCC Rcd 12603 ¶ 59 (2004).

<sup>40</sup> New ICO Satellite Services G.P., Comments on Consolidated Application for Authority to Transfer Control, MB Docket No. 07-57 (filed July 9, 2007).

and on-demand features.”<sup>41</sup> They further stated, “The nature of the satellite platform allows delivery of content to unlimited numbers of users. Interactivity through the satellite return channel allows us to support a much richer range of applications than is available through other networks.” The 2 gigahertz spectrum is so ideally suited to SDARS and SDARS-like applications that Sirius previously petitioned the FCC requesting that excess MSS spectrum in the 2 gigahertz band be specifically allocated to SDARS usage.<sup>42</sup>

The utility of the MSS satellite link was enhanced by the FCC’s decision to permit MSS operators to build hybrid systems that use terrestrial as well as satellite base stations—a capability called ancillary terrestrial component (ATC).<sup>43</sup> This development expanded the possibilities for MSS to support audio entertainment alternatives similar to satellite radio.

The deployment of hybrid MSS systems is by no means simply theoretical. It now appears that European satellite radio will use, in major part, MSS spectrum, as reflected in ITU “advance publication” filings by Inmarsat, Alcatel, Europa-Max and others.<sup>44</sup> In the United States MSS operators already have made most of the billion dollar expenditures necessary to construct their satellites and are subject to an FCC milestone process that is intended to prevent delay. For example, ICO, which plans to operate in the 2 gigahertz band, expects to launch its satellite later this year and has announced that

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<sup>41</sup> Inmarsat Global Limited, Petition for Declaratory Ruling to Provide Mobile Satellite Service to the United States Using the 2 GHz and Extended Ku Bands, File Nos. SAT-PDR-20050926-00184, SAT-AMD-20051116-00221, at 15 (filed Sept. 26, 2005).

<sup>42</sup> *Use of Returned Spectrum in the 2 GHz Mobile Satellite Service Frequency Bands*, Order, 20 FCC Rcd 19696 ¶ 52 (2005) (noting proposal by Sirius to reallocate 2 GHz spectrum to SDARS).

<sup>43</sup> *Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Bands; Review of the Spectrum Sharing Plan Among Non-Geostationary Satellite Orbit Mobile Satellite Service Systems in the 1.6/2.4 GHz Bands*, Report and Order and Notice of Proposed Rulemaking, 18 FCC Rcd 1962 (2003). The FCC found that this action would “enhance” the ability of MSS providers “to offer high-quality, affordable mobile services on land, in the air and over the oceans without using any additional spectrum resources beyond spectrum already allocated and authorized by the [FCC] for MSS in these bands.” *Id.* ¶ 1; *see also id.* ¶ 32 (discussing increased economies of scale).

<sup>44</sup> *See* “Description of Thuraya Satellite Network,” Doc. No. ECC PT10(06)15 (May 30, 2006); “Contribution describing the New Mobile System,” Doc. No. ECC PT1(05)INFO 08 (May 4, 2005); and “Eutelsat Projects for Hybrid Satellite-CGC Systems in the S-UMTS Bands,” Doc. No. JPTMSS2GHz(05)INFO06 (Dec. 5, 2005).

in the spring of 2008, it will begin to offer a multi-media subscription service to mobile users, for a monthly fee, to be delivered via satellite and supplemented by a terrestrial repeater network.<sup>45</sup> ICO's planned service appears to be directly competitive with certain of XM's and Sirius's offerings, and TerreStar soon will be capable of providing audio entertainment services akin to satellite radio.

As discussed below, mobile satellite service can be combined with storage in the consumer receiver. In such configurations, the mobile satellite service would not need to supply all the content all the time—rather it would be used to provide live program services. As a result, only a few hundred kilobits of downlink capacity would be needed from the satellite. The two-way capability of mobile satellite service would enable interactive applications and the release of spectrum assigned to radio services that were not being listened to in specific cells.

### ***Wireless Communications Service***

The wireless communications service (WCS) is located in two blocks (2305–2320 and 2345–2360 megahertz) just above and below the SDARS band occupied by XM and Sirius. Although the FCC divided this band into relatively small units—there are 165 WCS licenses—those licenses are held by only 16 different firms. Even that count of 16 firms is deceptive. Some firms have only a few licenses—for example, Guam Cellular and Paging has the license for Guam and the Northern Marianas, and a total of seven firms have three or fewer licenses. Three firms hold more than 50% of the licenses; five firms hold more than 75%.<sup>46</sup> The rules for this band permit flexible use, including use for satellite audio systems such as those operated by XM and Sirius.<sup>47</sup> Creation of a satellite-based DARS service in this spectrum would require relatively few spectrum consolidation transactions.

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<sup>45</sup> News Release, *ICO Selects Alcatel-Lucent and Hughes for Alpha Trial*, May 2, 2007, at <http://investor.ico.com/ReleaseDetail.cfm?ReleaseID=240320> (last visited June 28, 2007) (describing its service as “a converged mobile media service which addresses a wide variety of consumers’ entertainment and communication needs, all based upon ICO’s next-generation geostationary satellite (ICO G1) and the deployment of an Ancillary Terrestrial Component (ATC)”); see also *New ICO Satellite Services G.P., Application to Extend Milestones*, Memorandum Opinion and Order, 22 FCC Rcd 2229 ¶ 21 (2007).

<sup>46</sup> Examination of WCS licenses using the FCC ULS license search option, July 17–18, 2007.

<sup>47</sup> See 47 C.F.R. § 27.2(c). Note, SDARS operation is not permitted in 2305–2310 megahertz.

WCS can also be used for mobile multi-media services that do not use satellites. This is precisely what XM proposed to do with WCS frequencies several years ago.<sup>48</sup> Thus, even if it were not practical to provide satellite DARS in the WCS frequencies, it would still be possible to provide comparable audio entertainment services using terrestrial technology.<sup>49</sup> This approach is not only technically feasible, but as evidenced by XM's previous business plan and acquisition proposal in 2005, it could realistically be accomplished in a timely and economic fashion.

### ***Spectrum Opportunities***

#### **Television White Space**

The term *white space* refers to regions in a television channel but outside the coverage of any station. For example, television channel 3 is used by broadcast stations in Philadelphia, Pennsylvania, and Richmond, Virginia. Annapolis, Maryland, is located midway between Philadelphia and Richmond. Residents of Annapolis cannot receive channel 3 signals from either the Philadelphia or Richmond stations—Annapolis is in the channel 3 white space. Under the technical rules governing television, it is impossible to operate a television station on channel 3 in Annapolis because doing so would generate interference to the reception of the Philadelphia and Richmond signals. However, that white space can be used for other applications—particularly low-power applications that do not generate interference over great distances. The FCC has an ongoing proceeding considering the possible authorization of operations in the white space.<sup>50</sup> Note that the television white space has a certain swiss-cheese aspect; it occurs in small geographic regions surrounded by regions filled with television coverage.

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<sup>48</sup> See Application for Transfer of Control of WCS Wireless License Subsidiary, LLC from WCS Wireless, Inc. to XM Satellite Radio Holdings, Inc., Consolidated Opposition of XM Satellite Radio Holdings Inc. to Petitions to Deny, WT Docket No. 05-256, at 2-3 (filed Aug. 17, 2005); *id.* at 14 (“XM proposes to provide a subscription mobile multimedia services, which does not require the operation of a satellite and is not subject to the limitations that may apply to SDARS repeaters.”).

<sup>49</sup> As XM noted when it sought the WCS frequencies, providing SDARS using this band would require “significant additional steps,” such as “acquiring licenses to use WCS spectrum in additional markets, obtaining orbital locations, coordinating frequencies internationally, and obtaining Commission space station licenses, among other things.” *Id.* at 14.

<sup>50</sup> *In The Matter of Unlicensed Operation in the TV Broadcast Bands*, FCC ET Docket No. 04-186.

Jackson and Robyn analyzed the extent of the television white space and found that there is substantial white space—particularly outside the most crowded urban regions.<sup>51</sup> Their calculations show that slightly more than 70% of the population lives at a location where there are 60 megahertz or more of spectrum in the white space.<sup>52</sup> This white space presents an opportunity for additional wireless service.

One option for use of the white space would be for the FCC to license firms to operate in the white space subject to the condition that they not cause interference to the reception of broadcaster television signals. Engineering a system to avoid interference would probably require the use of directional antennas and low powers. Hence, it might be more expensive to build out substantial coverage in these frequencies than in the 700 megahertz band. But, note that a firm given access to the white space would have substantially more spectrum available for its use than would a combined XM/Sirius.

Alternatively, the FCC could authorize unlicensed operation in the TV white space. Depending on the power levels permitted, such an unlicensed band could also support an audio distribution service. Several parties have suggested that the TV white space could support wireless Internet access. If the FCC rules permitted operation of an economical Internet access service, they would also permit operation of a wireless audio service.<sup>53</sup> Such a service could be built out as a stand-alone service, or it could be built as a complement to a service that used other transmission media as well.

### **Other Lower 700 Megahertz Licensees**

In addition to QUALCOMM's 6 megahertz and the 12 megahertz used by Hiwire, the spectrum known as Blocks A, B,, and E, consisting of 30 megahertz more spectrum, have yet to be auctioned. The rules governing these spectrum blocks are quite flexible. An A- or B-Block licensee could deploy MediaFLO or a similar technology in the entire 12 megahertz.

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<sup>51</sup> Comments of Charles L. Jackson and Dorothy Robyn, *In The Matter of Unlicensed Operation in the TV Broadcast Bands*, FCC ET Docket No. 04-186, January 31, 2007.

<sup>52</sup> Ibid, Figure 2 at p. 19. Calculations by others have reached similar conclusions. It is important to note that the amount of the white space depends on the protection given to the reception of television signals.

<sup>53</sup> Also note that any reasonable wireless Internet access service would be able to support streaming audio applications. Thus, a wireless Internet access service would provide a wireless audio service.

A B-Block licensee providing a service that was predominantly video could still provide an audio capacity that was a significant fraction of that of the combined XM/Sirius enterprise. An A- or B-block licensee that chose to provide a service that was exclusively audio would have more capacity (roughly 12 million bits per second) than the capacity of the combined XM/Sirius enterprise (roughly 9 million bits per second).

Block E consists of a single 6-megahertz-wide block of unpaired spectrum (old television channel 56). It is a complement to the adjacent D Block, which is currently being used by QUALCOMM for MediaFLO. QUALCOMM is a natural bidder for the E block when it is auctioned. Even if another entity purchased that block, it would be quite reasonable for that E-Block licensee to use that spectrum for a service similar to QUALCOMM's MediaFLO. Indeed, it would make great economic sense for an E-Block licensee other than QUALCOMM to adopt the MediaFLO technology and to work in a cooperative fashion with QUALCOMM to provide complementary services with double the capacity of QUALCOMM's current service.

To sum up, in addition to the 6 megahertz QUALCOMM uses for MediaFLO and the 12 megahertz that Hiwire uses, there are 30 megahertz of not-yet-licensed spectrum in the lower 700 megahertz band. It appears quite natural to use at least 6 megahertz (Block E) for a service like MediaFLO. In addition, the licensees of the other blocks can use some or all of their spectrum for such services if they find that an attractive option.

### **Upper 700 Megahertz**

The FCC is in the process of developing service rules for the radio spectrum at 746–794 megahertz (old television channels 60 to 67). The outcome of that rulemaking process is, of course, unclear. However, it appears highly likely that there will ultimately be 36 megahertz of spectrum made available for commercial uses. This spectrum will be paired—hence it will be attractive for use in two-way services similar to cellular and PCS.

This spectrum has radio coverage characteristics similar to those of the lower 700 megahertz block discussed above. However, the FCC will not permit use of powers as high as those permitted in the lower 700 megahertz band.

It appears highly likely that, whatever the rules adopted by the FCC, a large fraction of this 36 megahertz of commercial spectrum will be licensed in a fashion that permits the licensee to use it for audio services just as AT&T, Alltel, Verizon, and others do today with their cellular and PCS spectrum.

### **Unlicensed Spectrum**

The FCC has made substantial amounts of spectrum available for unlicensed use. The uses of this spectrum that are most familiar to the general population are for cordless telephones and wireless local area networks (most often WiFi networks).

WiFi already provides a wireless alternative and complement to other wireless networks. The Apple iPhone can use a WiFi connection to access the web as can many personal computers. The software for managing Verizon Wireless' EV/DO access card provides integrated control of the EV/DO card and the computer's WiFi capabilities. Verizon Wireless provides an option for the computer to automatically switch from the Verizon Wireless network to a WiFi network when the computer is in range of a WiFi network.

Slacker has announced that its Portable Player will use WiFi to access the Internet and download programming for later playback. Sirius's Stiletto SL100 portable receiver has a WiFi option—it can play streaming music delivered over a WiFi connection as well as play music delivered over a satellite link.<sup>54</sup> Yahoo and MP3 device maker Sandisk partnered on the recently launched Sandisk Sansa Connect WiFi enabled MP3 player, optimized for Yahoo's Yahoo Music To Go music subscription service, which provides personalized radio and unlimited music downloading through the PC and over WiFi; Pandora recently announced plans for launching a similar device with Sandisk.<sup>55</sup>

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<sup>54</sup> <http://www.sirius.com/gs/stiletto/wifi-insert-091906b.pdf>.

<sup>55</sup> "Prototype of Pandora Wifi Device Shown Tonight in San Francisco," *at* <http://www.techcrunch.com/2007/05/23/prototype-of-pandora-wifi-device-shown-tonight-in-san-francisco/>.

The above systems use WiFi to complement other communication channels. WiFi has the great advantage of being widely available, and its installation cost is justified by applications other than audio services. However, one can imagine a service provider developing a specialized access point—one designed to transmit signals to compatible handsets. Such an access point could be built to have a range several times greater than that of WiFi hot spots.

### **Other Spectrum Not Yet Licensed**

In proceedings known informally as AWS II and AWS III, the FCC is developing rules that would permit the licensing of additional spectrum in the 2 gigahertz region. Together these proceedings could make about 40 megahertz more spectrum available. It appears highly likely that it would be made available under rules that would permit it to be used for services like PCS and wireless Internet access.

The FCC recently reaffirmed its earlier decision to make the 3650–3700 megahertz band available under a licensed but dynamically shared basis.<sup>56</sup> This spectrum is a good candidate for services somewhat like WiFi. Thus, it could provide another supplementary communications channel—one that handsets use to fill up with content while they are in range.

### ***Systems Using Multiple Technologies and Multiple Bands***

No law of man or physics limits a service to use only a single technology or spectrum band. Several services use multiple bands and technologies today. When Verizon provides MediaFLO service to one of their wireless customers, voice and data services are provided in the cellular and PCS bands using cdma2000 and the streaming video is delivered using OFDM in the 700 megahertz band (former television channel 55). Slacker's service also illustrates this principle well—a Slacker Personal Radio Player will be able to connect wirelessly over both WiFi and satellite links; in addition, it will connect to a computer using a USB cable. Last month, T-Mobile announced its *HotSpot@Home* service that allows people to make phone calls over both T-Mobile's

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<sup>56</sup> See "Memorandum Opinion and Order In the Matter of Wireless Operations in the 3650–3700 MHz Band," ET Docket No. 04-151, FCC 07-99, June 7, 2007.

*PCS network and WiFi hotspots, including WiFi access points connected to DSL or cable modem service at home. Both XM and Sirius supplement their satellite service with options for listening to programming delivered over the Internet. Sirius sells an Internet-only service and an Internet-based supplement to their consumer satellite service.*<sup>57</sup> NextWave offers a nationwide wholesale wireless service using several bands.

Similarly, one can envision a service that uses both HD-radio signals and signals transmitted in the television white space. The relatively high-power HD-radio signals would provide wide area coverage of what might be called foundation services. The white-space service would provide coverage in smaller regions—but coverage with greater capacity. The white space capacity could be used to upload programs and albums onto handsets, whereas the HD-radio signal could be used to carry sports, weather, and other live audio materials.

More generally, all of the technological and spectrum options discussed above can be combined in various proportions. For example, a service provider might use a combination of BRS, mobile satellite service, and unlicensed hot-spot transmitters operating in 2.4 gigahertz to provide an audio service with a universal footprint, a large number of channels in urban areas, and specialized services within the coverage of the hotspot transmitters.

Thus, no one technology or frequency band should be evaluated on its capabilities alone. The shortcomings of one technological option may be remedied by the features of another. Each alternative should be considered as part of a portfolio of alternatives—a portfolio from which service providers and consumers will be able to jointly construct the most efficient mix of service alternatives.

Many of these alternatives can be used for audio distribution should the licensees believe that there is a reasonable business plan for such audio services. Other alternatives, such as use of the television white space or operation in the yet-to-be-auctioned lower 700

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<sup>57</sup> See <http://www.sirius.com/servlet/ContentServer?pagename=Sirius/Page&c=FlexContent&cid=1158082415620>.

megahertz A, B, and E Blocks (30 megahertz of spectrum) require the FCC to complete the process of making that spectrum available.

### ***Systems Combing Streaming Media and Storage***

For decades people have put forward a variety of system designs that transmit programming for playback later, and several such systems have been marketed. Two such systems have become notable successes. The first is the personal digital video recorder; the best-known example is TIVO. These devices require user to select in advance the programs to be recorded; such selection can be quite broad—users can select categories such as “The Sopranos” or “Kevin Bacon movies” or quite specific—users can select tomorrow’s basketball game on channel 9. A second notable success is Apple’s iPod. iPod users can download music or videos from Apple’s iTunes store or from other providers and can play the programming back when they wish to do so. Distribution of programming to iPods for later replay has become so popular that the word *podcasting* was coined to describe it.<sup>58</sup>

The continuing growth in the storage capacity of hard disk drives and flash-memory chips has made it possible to store large amounts of programming in relatively low-cost memory units. Storage capacities that a few decades today characterized a large computer center are now built into music players and cameras—the smallest storage option for a classic iPod is 30 gigabytes. The various iPod models—the iPod, the iPod nano, and the iPod shuffle—have storage capacities ranging from 1 gigabyte to 80 gigabytes.

A simple calculation puts the impact of these storage options in context. Consider a reasonable quality audio service—one requiring a 50 kilobit per second data stream. Such a service would require 22.5 megabytes per hour of programming. A full week’s programming, 24/7, would require a little less than 4 gigabytes of storage.

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<sup>58</sup> A Google search on the terms *podcast* and *podcasting* yields 130 million hits. The word was added to the *Oxford English Dictionary* in 2005.

Of course, a service provider does not need to provide a service *that depends exclusively* on stored programming or exclusively on transmitted programming—rather the service provider can use a mix of the two capabilities.

Consider a broadcaster that wished to provide a multi-channel audio service. It could provide a few, say 10, live audio channels at all times. These channels could provide news, sports, weather, traffic, and emergency announcements and would only require about 5% of the broadcaster's capacity.<sup>59</sup> At off-peak times, say midnight to 6 a.m., the broadcaster could devote half its capacity, 3 megabits per second, to downloading relatively static content to consumer receivers; in 6 hours, a handset could download 600 hours of audio programming.<sup>60</sup> Similarly, consider the transmission of weather forecasts. A service offering current weather forecasts could transmit one such forecast in a 5-minute burst every hour for storage in the handset. A user who tuned to the stored weather forecast would have the advantage of hearing the forecast from the beginning rather than tuning to it in progress; the system would require a factor of 12 less in transmission capacity than would one that constantly streamed the weather forecast.

Many of the service providers discussed above, for example, QUALCOMM, Crown Castle, and BRS/EBS licensees such as Sprint, could similarly use a system design that combined occasional high-speed access with a limited bit-rate streaming service (250–500 kilobits per second) to provide a reasonable match to the non-caching services provided by XM/Sirius.<sup>61</sup>

A service based on storage in the consumer handset faces some tradeoffs. The handset must be powered up at the time it is supposed to receive programming that is to be stored. The storage capability will probably increase the cost of handsets and lower battery life. But, note that a hybrid system that uses both storage and streaming content needs much less capacity for the streaming (live) component; use of wireless telephone service

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<sup>59</sup> The capacity calculation is 10 channels at an average bit rate of 30 kilobits per second, for a total bit rate of 300 kilobits per second. It is assumed that the mobile service transmissions achieve about 6 megabits per second if using the entire television channel capacity; 300 kilobits per second is one-twentieth or 5% of a television station's total capacity.

<sup>60</sup> This would require at least 8 gigabytes of storage in the consumer handset.

<sup>61</sup> Qualcomm's MediaFLO USA network has a caching capability they call Clipcasting.

provider systems or a variety of satellite systems may therefore be an option that does not consume excessive system resources.

Systems that combine transmission and storage are not theoretical concepts; rather, they are being deployed today. QUALCOMM's MediaFLO system includes an option called Clipcasting in which short segments, for example, a sports report or a news broadcast, are downloaded to handsets on a regular basis for playback on demand. Slacker's Personal Radio Players will download "stations"—streams of programming with a consistent theme—from Slacker's system for later playback. Sirius sells several receivers that permit recording programs as well as pausing and rewinding. XM sells receivers that permit playback of MP3s and WMA files as well as scheduling recording of XM programs for later playback. And, of course, all the major wireless carriers offer services that permit the purchase and downloading of songs to handsets.

The combination of storage in the handset and using multiple bands creates a wide variety of options for providing a service similar to that of XM/Sirius. For example, a service provider could combine a storage option, fed over television broadcast stations during the late night/early morning, with a live option of about 300 kilobits per second fed over television stations and over an MSS system such as ICO. Such a service would appear to the consumer to be much like that offered by XM and Sirius today.

## **Conclusions**

Depending on how one counts, there are about a dozen alternate wireless delivery paths for audio services capable of supporting hundreds or thousands of channels. The discussion above addresses 15 alternatives. One might choose to classify some of these alternatives (MediaFLO, Hiwire, and yet to be licensed operators in the lower 700 megahertz band) as variations of one single option—use of the 42 megahertz in the lower 700 megahertz band. On the other hand, MediaFLO, Hiwire, and Modeo, although they have technical similarities, are independent firms that identify and pursue business opportunities separately. Each one is bringing its own approach to the digital distribution of media content to mobile consumers.

Some of these alternatives, such as AT&T Wireless's audio services, already offer dozens or hundreds of channels. Other alternatives, for example, V Cast Mobile TV from Verizon Wireless and ICO's soon-to-be-launched interactive multi-media service, provide additional services such as video or games. Many of these alternatives include attractive two-way interactive features as well as storage and replay capabilities that were not affordable at the time XM and Sirius committed to their system architecture and that are not available in the receivers most XM and Sirius customers have today.

The spectrum licensed today that can be used to provide offerings much like those of XM and Sirius is enormous. MediaFLO, Hiwire, and Modeo alone have 23 megahertz of spectrum—significantly more than the 8 or 9 equivalent megahertz that XM and Sirius together have.<sup>62</sup> The BRS/EBS band is almost 200 megahertz—dwarfing the SDARS spectrum.

In addition, the FCC has the option to make more spectrum available under rules that permit its use for multichannel audio distribution.

The combination of existing alternatives—systems operating today, licensed systems in the process of being built out, spectrum not yet licensed, unlicensed spectrum, and spectrum that the FCC could make available for audio services—together with a variety of sophisticated storage and playback designs create an enormous universe of media choices for consumers.

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<sup>62</sup> Recall the discussion at page 3 of the fact that SDARS systems transmit multiple copies of their signals to overcome the effects of signal blockage and signal fading.

## About the Author

Dr. Charles L. Jackson is an electrical engineer who has worked extensively in telecommunications and wireless. He has been both a digital designer and a systems programmer. He works as a consultant and as an adjunct professor at George Washington University, where he has taught graduate courses on mobile communications, wireless networks, computer security, and the Internet. Dr. Jackson has consulted on spectrum and telecommunications policy issues for several governments, including New Zealand, Panama, Jamaica, United Kingdom, Germany, Latvia, and the United States. He has also consulted for major corporations and industry associations on those issues. He was the first to invent combinatorial auctions—formulating them in the context of radio license auctions. Dr. Jackson served three terms on the FCC's Technological Advisory Council. Dr. Jackson previously worked at both the FCC and the House Commerce Committee. He holds two U.S. patents and has one other patent pending. Dr. Jackson received his doctorate from Massachusetts Institute of Technology.